Claims

1. A machining device which machines a material (4, 13) by non-linear absorption of machining laser radiation (2) and which comprises:
- a laser radiation source (9) emitting said laser radiation (2), and
- optics (3) focusing the laser radiation (2) for non-linear absorption into or onto the material (4, 13),

characterized by

a polarization modulator (10) which causes the focused laser radiation (2) to be linearly polarized, with a polarization direction (23) varying across the beam cross-section (15).

2. A machining device which machines a material (4, 13) by non-linear absorption of machining laser radiation (2) and which comprises:
- a laser radiation source (9) emitting said laser radiation (2), and
- optics (3) focusing the laser radiation (2) for non-linear absorption into or onto the material (4, 13),

characterized by

an intensity modulator (24) which modifies an intensity distribution of the laser radiation (2), thereby attenuating the radiation intensity (I) near the optical axis.

3. The machining device as claimed in claim 1 or 2, characterized by a deflecting unit (12) which modifies a spatial position of the focus in the material (4, 13) by controllable deflection of the laser beam (2).

4. The machining device as claimed in any one of the above claims, characterized in that the modulator (10, 24) is arranged between the laser radiation source (9) and the deflecting unit (12).

5. The machining device as claimed in any one of the above claims in combination with claim 1, characterized in that the laser radiation source (9) emits linearly polarized radiation (2) and the polarization modulator (10) inhomogeneously modifies the polarization direction (23) of the laser beam (2) across the beam-cross section (15).

6. The machining device as claimed in any one of claims 1, 2 or 3, characterized in that the modulator (10, 24) is arranged within the laser radiation source (9) such that the laser radiation source (9) emits laser radiation (2) having a polarization direction (23) which varies across the beam cross-section (15) or with modified intensity distribution.

7. The machining device as claimed in any one of the above claims in combination with claim 1, characterized in that the polarization modulator (10) is adjustable, in particular controllable, with respect to the variation of the polarization direction (23).

8. The machining device as claimed in claim 7, characterized by a control unit which modifies the variation of the polarization direction (23) during operation of the machining device.

9. The machining device as claimed in any one of the above claims, characterized in that the laser radiation source (9) emits pulsed laser radiation (2) with a pulse duration of less than 10,000 fs, in particular less than 500 fs.

10. The machining device as claimed in claim 7, characterized by a pulse repetition frequency of more than 100 kHz, in particular more than 450 kHz.

11. The machining device as claimed in any one of the above claims in combination with claim 2, characterized in that the intensity modulator (24) blocks out radiation components near the optical axis.

12. The machining device as claimed in any one of the above claims in combination with claim 2, characterized in that the intensity modulator (24) effects energy distribution away from regions near the optical axis.

13. A method for machining wherein the laser radiation (2) is focused into or onto the material (4, 13), the parameters of the laser radiation (2) and the focusing being selected such that a non-linear absorption of the laser radiation (2) is caused in the material (4, 13), characterized in that the laser radiation (2) is linearly polarized before focusing, with a polarization direction (23) varying across the beam cross-section (15).

14. A method for machining, wherein the laser radiation (2) is focused into or onto the material (4, 13), the parameters of the laser radiation (2) and the focusing being selected such that a non-linear absorption of the laser radiation (2) is caused in the material (4, 13), characterized in that the intensity distribution of the laser radiation (2) before focusing is modified, with the radiation intensity (I) being attenuated near the optical axis.

15. The method as claimed in claim 10 or 11, characterized in that the position of the focus of the laser radiation (2) is shifted at least two-dimensionally.

16. The method as claimed in any one of the above method claims, characterized in that the variation of the polarization direction or the modification of the intensity distribution is adjusted during machining.

17. The method as claimed in claim 16, characterized in that a quality parameter of machining is determined and controlled, with the variation of the polarization directions (23) being used as the manipulated variable.

18. The method as claimed in any one of the above method claims, characterized in that the laser radiation (2) is focused in the vicinity of the surface of the material (4, 13) to be machined, with the distance of the focus from the surface of the material (4, 13) to be machined lying, in particular, approximately in the range of the Rayleigh length of the radiation (2).

19. The method as claimed in any one of the above method claims, characterized in that cut surfaces are formed in the material by areal sequential arrangement of optical breakthroughs (11) generated by non-linear absorption, which cut surfaces are located in the material (4) and have a cutting line extending, in particular, up to the surface of the material (4).